FORM PTO-1390 (REV 12-97) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
5138	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
09/581565	
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE
PCT/DE98/03300	03.11.98
PRIORITY DATE CLAIMED	
18.12.97 06.05.98	

TITLE OF INVENTION
PIEZOELECTRIC TRANSMITTER

APPLICANT(S) FOR DO/EO/US
Thomas HAHN, Hans-Joachim WELSCH, Martin STAUT

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [XX] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (executed)
10. [ ] A translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information:

Verified English Translation of PCT International Preliminary Examination Report dated November 2, 1999

533 Rec'd PCT/PTO 15 JUN 2000

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/581565	PCT/DE98/03300	5138

17. [X] The following fees are submitted:	CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):	
Search Report has been prepared by the EPO or JPO $840.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) $670.00	
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $690.00	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $970.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... $ 96.00	

ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 840.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$ 0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	10 - 20 =		x $ 18.00	$ 0.00	
Independent claims	1 - 3 =		X $ 78.00	$ 0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			$260.00	$ 260.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1100.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28). +				$ 0.00	
SUBTOTAL =				$ 1100.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$ 0.00	
TOTAL NATIONAL FEE =				$ 1100.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$ 0.00	
TOTAL FEES ENCLOSED =				$ 1100.00	
				Amount to be refunded:	$
				charged:	$

a. [X] A check in the amount of $ 1100.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-3690 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

BREINER & BREINER
115 N. Henry Street
P.O. Box 19290
Alexandria, VA 22320-0290
703-684-6885

Mary Breiner
SIGNATURE

Mary J. Breiner
NAME

33,161
REGISTRATION NUMBER

Date: June 15, 2000

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GA990506PCT

Piezoelectric Transmitter

The present invention relates to a piezoelectric transmitter, like those that can be used as ultrasound transmitters.

The effects of ultrasound propagation, in particular sound velocity and sound dampening, are influenced by temperature. Furthermore, the piezoelectric constants of the piezoceramics very often employed as materials in the conversion of electro-mechanic energy in ultrasound transmitters are distinctly temperature dependent. In piezoceramic ultrasound transmitters, therefore the result is temperature-dependent acoustic transmission behavior.

Acoustic flow-through measuring devices and level detectors operating with ultrasound transmitters, therefore, usually require measuring the temperature prior to or during operation.
In many cases in the state of the art, an external temperature sensor measures the temperature. However, in this instance, in order to determine the temperature directly at the acoustic measuring point next to the acoustic transmitter, the external temperature sensor has to be guided to the measuring point, which requires additional cabling and complicated arrangements.

It is the object of the present invention to provide a piezoelectric transmitter that permits determining the temperature in a simple manner directly at the acoustic measuring point.

This object is solved with the features of the piezoelectric transmitter according to claim 1.
Advantageous embodiments of the present invention are the subject matter of the subclaims.

A key element of the present invention is that the piezoelectric transmitter comprises a piezoelectric substrate, preferably a piezoceramic provided with a first electrode on a first surface and a second electrode on a second surface opposite the first surface. The first electrode does not cover the first surface completely. As a result, there is an electrode-free rim surface. This can be realized by selecting for the preferably circular electrode a diameter that is smaller than the diameter of the circular substrate surface. In this way, the diameter of the employed piezoelectric substrate is larger than the required radiating surface (aperture) of the piezoelectric transmitter. This aperture is determined approximately by an overlapping of the two opposite electrodes.

A component with temperature-dependent behavior is disposed respectively integrated on the electrode-free rim surface. One connection of this component is conductively connected to at least one of the two electrodes.

This type of piezoelectric transmitter construction permits determining the temperature directly at the acoustic measuring point via the temperature-dependent component. The integration of the component on the surface of the piezoelectric substrate guarantees uncomplicated temperature determination. Parallel or serial connection of the component to the capacitor formed by the two electrodes permits measuring the temperature directly via the two-pole leads for the electrodes. Therefore, no additional leads for the temperature sensor respectively the temperature-dependent component are needed, obviating expensive, complicated cabling.

Provision of connecting pads formed by the first and/or second electrode on a surface of the piezoelectric substrate permits realizing the integration of the temperature-dependent component by means of a simple connecting method (claims 3 and 4). No additional wiring is needed between the electrode or electrodes and the component. The invented piezoelectric transmitter can therefore be produced with little effort.

The present invention is made more apparent using a preferred embodiment with reference to the drawings. Shown is in:

Fig. 1 a rear view (a), a front view(b) and a side view (c) of an embodiment of an invented piezoceramic transmitter before placement of the component;

Fig. 2 the rear view of the transmitter from fig. 1 with the integrated component (here: temperature-dependent resistor);

Fig. 3 the transmitter from fig. 2 in a housing; and

Fig. 4 a basic circuit of the circuitry of the component with the capacitor formed by the two electrodes, as a parallel (a) or serial circuit (b).

Fig. 1 shows a side view, a rear view and a front view of an embodiment of an invented piezoceramic transmitter before it is provided with a temperature-dependent component. In the depicted embodiment, a circular, disk-shaped piezoceramic is employed as the substrate (1). An also circular electrode (2) (except for noses 4,5) whose diameter is smaller than that of the piezoelectric ceramic is disposed on the rear side of the ceramic (see fig.1(a)).

As the size of the electrode determines the radiating surface of the transmitter, in the present case a piezoceramic is therefore employed whose diameter is larger than the radiating surface (aperture) of the transmitter required for the intended application.

Due to the different diameters of the piezoceramic and the rearward electrode, there is an electrode-free rim surface (3) on the rear-side surface of the ceramic. The rearward electrode is also provided with two noses (4,5) which extend into the electrode-free rim. These noses form connecting pads for the subsequent contacting of the electrode to a supply lead (nose 4) and to the component having the temperature-dependent behavior (nose 5).

In the front view (b) of fig. 1 it can be seen that in the present embodiment the front electrode (6) extends over the entire front surface of the piezoceramic. This front electrode is also provided with two noses (7,8) running around the rim of the disk-shaped piezoceramic to form two connecting pads (7,8) in the electrode-free rim area (3) on the rear side. These two connecting pads, like the rear-side electrode (2), are provided with a supply lead (nose 7) and the component (nose 8) for contacting the front electrode.

Partial picture (c) shows a sectional view through the line A-A´ in the partial picture (a). One can see here the piezoelectric ceramic (1), the rearward electrode (2) and the front electrode (6) with the nose (8) running around the rim of the piezoceramic to form a connecting pad on the opposite surface. In picture (c) of fig. 1, for clarity the electrodes are drawn at a distance from the piezoceramic. Actually, however, they are in contact with the piezo-ceramic.

Conventional materials such as lead zirconium titanate (PZT)can be employed as materials for the piezoceramic material. Preferably silver, gold or nickel are used as the electrode materials. Typical dimensions of the piezoceramic are a thickness ranging from 1 to 4 with a diameter ranging from approximately 10 - 30 mm.

Fig. 2 shows the preferred embodiment of fig. 1 with an integrated temperature-dependent resistor (9) and disposed supply leads (10) to the electrodes. The circuit of the temperature-dependent resistor to the capacitor formed by the two electrodes corresponds, in the present embodiment, to a parallel circuit as shown in the diagram in fig. 4(a). The leads can, for example, be soldered to the connecting pads. (4,7).

In the invented embodiment of the piezoceramic transmitter, advantageously the piezoceramic is simultaneously utilized

as a board. The connecting pads that are formed by the electrodes themselves permit realization of a very simple connecting method with minimum cabling.

A transmitter of this type can, for example, be used to measure the level of gas bottles from the outside.

The temperature-dependent resistor can, for example, be a PTC or a NTC resistor. Another type of temperature sensor that should preferably be built in the SMD manner is also possible.

Fig. 3 shows a side view of an invented transmitter having a coupling layer (12) and an integrated temperature-dependent resistor (for example SMD-NTC(9)) in a housing (11). The connecting cables (10) are also shown.

Fig. 4 shows the two circuit variants integrated in the component. To be noted in realizing the parallel circuit as depicted in fig. 4a (and in fig. 2) is that the electric resistor of the component (here a temperature-dependent resistor) only minimally dampens the high-frequency ultrasound wanted signal for triggering the electrodes. In this case, for example, a high impedance NTC resistor should be employed in conjunction with a low impedance ceramic. For example, in realizing a 1.5 MHz transmitter which has an impedance of approximately 50 Ω (preferably the minimum impedance at this frequency), a NTC resistor with a resistance of at least 10 to 20 kΩ can be used.

In realizing a serial circuit as shown in fig. 4b, a low impedance PTC resistor should be employed in the serial circuit with a high impedance piezoceramic.

The depicted parallel circuit respectively serial circuit permits transmitting the temperature data with its low-frequency signal behavior over the same two-pole supply lead (10) that is also used for the high-frequency ultrasound data, thereby obviating the provision of additional supply leads. In particular, this simplified arrangement permits distinctly simplifying installation when using the transmitter.

The invented arrangement of the electrodes in conjunction with the provision of a piezoceramic whose diameter is larger than the needed radiating surface offers a very simple method of connecting the component to the electrodes by means of integrated connecting pads.

Of course, the shape and the precise dimensions of the piezoceramic and the electrodes depends on the respective application and are not limited in any manner in scope or spirit by the teaching of the present invention. Other

integratable components can be employed to determine the temperature instead of temperature-dependent resistors.

What Is Claimed Is:

1. A piezoelectric transmitter having a substrate (1) made of a piezoelectric material provided with a first electrode (2) on a first surface and a second electrode (6) on a second surface opposite said first surface, with on said first surface an electrode-free rim surface (3) being provided, on which is disposed a component (9) having temperature-dependent behavior and conductively connected via a connection to at least one of said electrodes (2,6).

2. A piezoelectric transmitter according to claim 1, characterized by said substrate (1) made of a piezoelectric material being a piezoceramic.

3. A piezoelectric transmitter according to claim 1 or 2, characterized by said first electrode (2) having a shape with a nose (5), which forms on said first surface a connecting pad via which the connection of said component (9) is conductively connected to said first electrode (2).

4. A piezoelectric transmitter according to one of the claims 1 to 3, characterized by said second electrode (6) having a shape with a nose (8), which runs around the rim of said substrate (1) and forms on said first surface a connecting pad via which said connection or an additional connection of said component (9) is conductively connected to said second electrode (6).

5. A piezoelectric transmitter according to one of the claims 1 to 4, characterized by the capacitor formed by said two electrodes (2,6) being connected in series to said component (9) and said component having low impedance in comparison to said substrate.

6. A piezoelectric transmitter according to one of the claims 1 to 4, characterized by the capacitor formed by said two electrodes (2,6) being connected in parallel to said component (9) and said component having high impedance compared to said substrate.

7. A piezoelectric transmitter according to one of the claims 1 to 6, characterized by said component (9) being a PTC resistor.

8. A piezoelectric transmitter according to one of the claims 1 to 6, characterized by said component (9) being a NTC resistor.

9. A piezoelectric transmitter according to one of the claims 1 to 8, characterized by said component (9) being built in the SMD manner.

Abstract

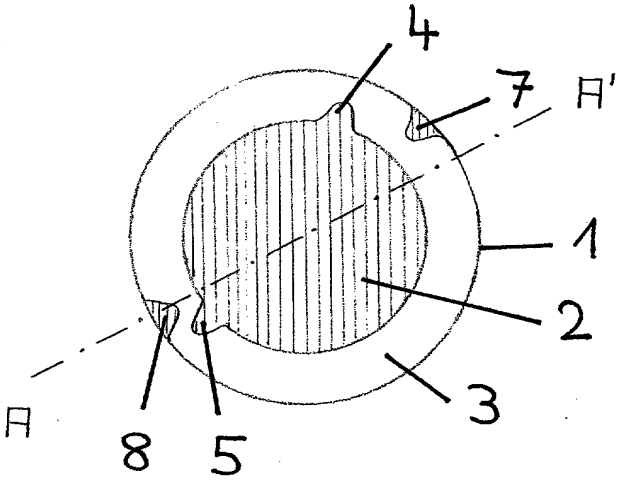
The present invention relates to a piezoelectric transmitter, like those used for ultrasound propagation, for example, in acoustic flow-through measuring devices or level detectors.

This piezoelectric transmitter preferably comprises a piezoceramic that is provided with a first electrode on a first surface and a second electrode on a second surface opposite said first surface. On the first surface an electrode-free rim surface is provided on which is disposed a component having temperature-dependent behavior. This component is conductively connected via a connection to at least one of the electrodes.

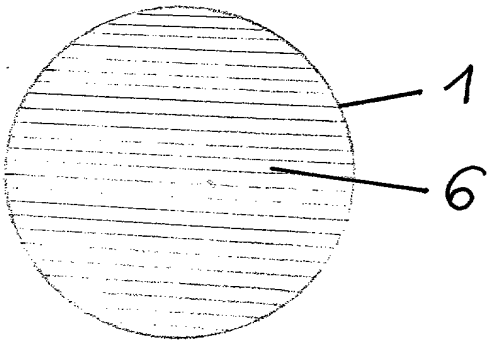
The invented piezoelectric transmitter permits measuring the temperature directly at the acoustic measuring point without additional cabling.

Fig. 1:

(a)



(b)



(c)

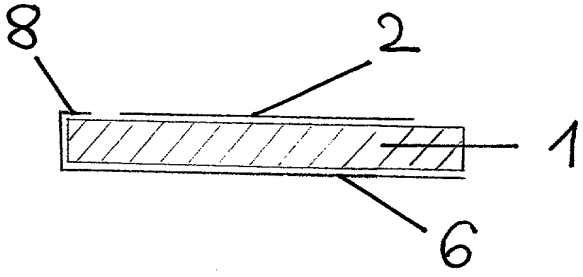


Fig. 2:

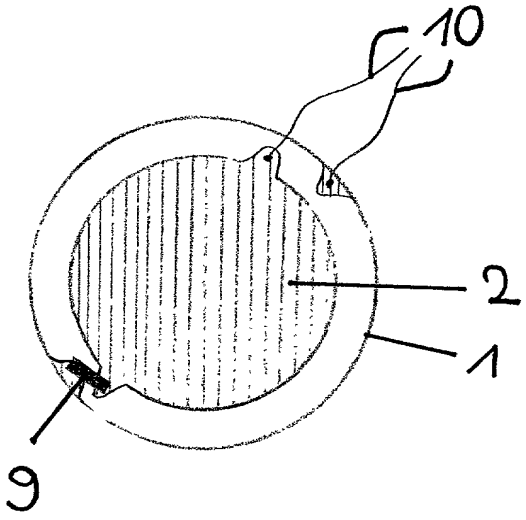


Fig. 3:

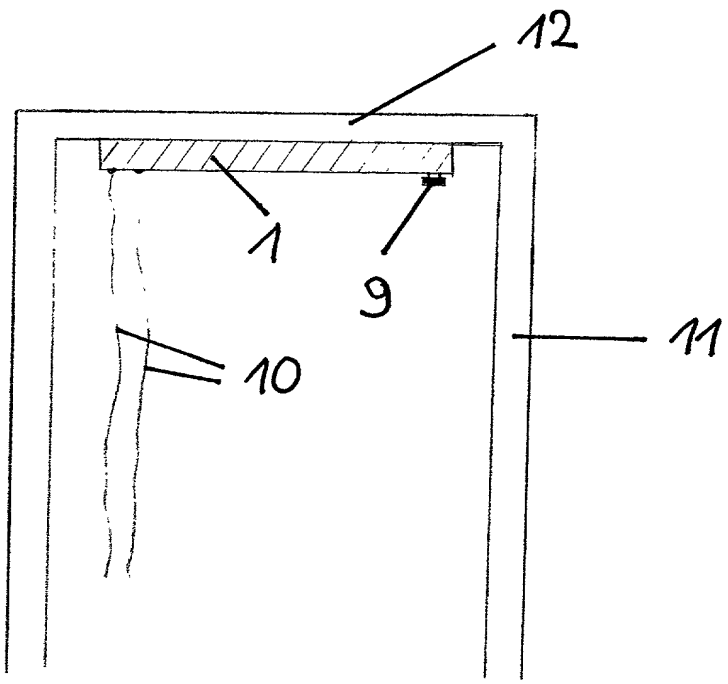


Fig. 4a:

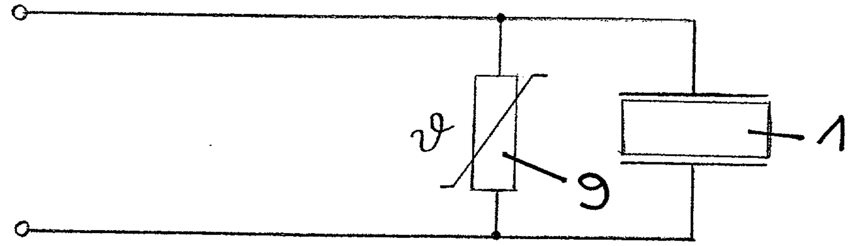
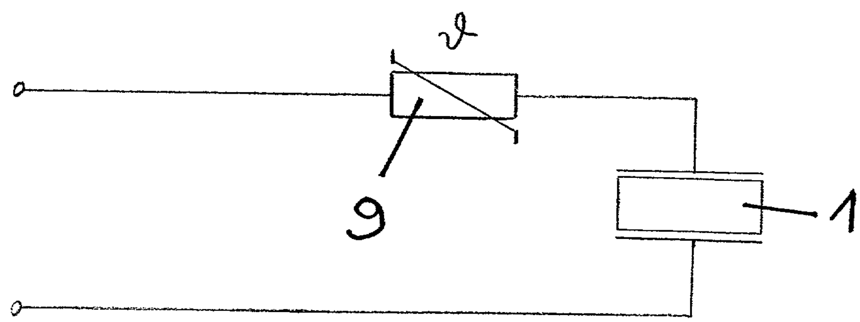


Fig. 4b:



COMBINED DECLARATION & POWER OF ATTORNEY Docket No. 5138

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.)	(Filing Date)	(Status-patented, pending, abandoned)
(Application No.)	(Filing Date)	(Status-patented, pending, abandoned)

I (we) hereby appoint the following attorney with full power of substitution to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

ALFRED W. BREINER, Reg. No. 18,676; THEODORE A. BREINER, Reg. No. 32,103; and MARY J. BREINER, Reg. No. 33,161.

Address all correspondence to -

BREINER & BREINER, 115 North Henry Street
P.O. Box 19290, Alexandria, Virginia 22320-0290

Address all telephone calls to -

Mary J. Breiner at (703) 684-6885

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION Docket No. 5138

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled PIEZOELECTRIC TRANSMITTER

,

the specification of which is attached hereto unless the following box is checked:

[X] was filed on November 3, 1998 as United States Application Number or PCT International Application Number PCT/DE98/03300 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Claimed
197 56 534.4 (Number)	Germany (Country)	18 December 1997 (Day/Month/Year Filed)	Yes [X] No [ ]
198 20 208.3 (Number)	Germany (Country)	6 May 1998 (Day/Month/Year Filed)	Yes [X] No [ ]
PCT/DE98/03300 (Number)	PCT (Country)	3 November 1998 (Day/Month/Year Filed)	Yes [X] No [ ]

COMBINED DECLARATION & POWER OF ATTORNEY Docket No. 5138

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor:
(given name, family name) Thomas HAHN

Inventor's Signature _____ Date 23.5.00

Residence: St. Ingbert, Germany Citizenship: German

Post Office Address: Rhodter Straße 8

D-66386 St. Ingbert, Germany

Full Name of Second Joint Inventor, if any
(given name, family name) Hans-Joachim WELSCH

Inventor's Signature _____ Date 23.5.00

Residence: St. Ingbert, Germany Citizenship: German

Post Office Address: Kohl-Weigandstraße 25

D-66386 St. Ingbert, Germany

Full Name of Third Joint Inventor, if any
(given name, family name) Martin STAUT

Inventor's Signature _____ Date 23.05.00

Residence: St. Ingbert, Germany Citizenship: German

Post Office Address: Knappenstraße 7

D-66386 St. Ingbert, Germany
